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EXPERIMENTAL INVESTIGATION ON EFFECT OF SHEAR CONNECTOR IN LIGHT WEIGHT CONCRETE

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ABSTRACT

Composite construction is well established for some decades as a construction method. The light steel gives two advantages which are cheaper and lighter. One of the important parameters which affects the ultimate strength of the composite section is the bond at the interface of the steel and the concrete which relies on the shear forces existing between the steel section and the concrete core where mechanical connectors are provided. Based on the literature survey, Stud connectors are to be used in this experimental work, because of its excellent load carrying capacity and better ductility. Lightweight concrete is now a commonly used material that can successfully replace normal density concrete and the presence of shear connector provides good bonding strength between steel section and concrete. The principal reason for using light weight concrete is the advantage of reducing the concrete element's self-weight. This weight saving permits larger spans or lower the weight of the steel section and lowers the cost of the foundations.

INTRODUCTION

The Applications of composite members consisting of concrete-steel sections have become increasingly popular in civil engineering structures in recent years. This is due to their advantages over the conventional concrete sections in terms of strength, ductility, energy absorption capacity, easy construction procedure and overall economy. Composite Steel-Concrete construction is widely used in buildings and bridges even in regions of high seismic risk. It is now common practice to use cold formed steel decks consisting of profiled sheets both as permanent formwork for the support of the soffits of reinforced concrete slabs and also as part of the tension steel in the composite profiled slab that is formed after the concrete has hardened. The construction should ensure monolithic action between the prefabricated and in-situ components so that they act as a single structural unit. Recent studies confirm that a reinforced concrete beam which uses cold formed profiled steel sheeting for

the vertical sides and soffit may result in reduced span to depth ratios from increased strength and stiffness.

Basically there are two methods of assembly in composite construction, namely,

a) The unpropped method, wherein the prefabricated units are made sufficiently strong to carry the dead weight of wet concrete constructional live load together with any incidental formwork which may be required.

b) The propped method wherein the prefabricated units are supported during the laying and curing of in-situ concrete so that when the props are removed the whole of the section is monolithic and carries the total weight of the concrete as well as live load.

Considerable investigations have been carried out in the past by many researchers with different ways of bonding between steel and concrete.

COLD FORMED STEEL

Cold formed steel structural members are cold formed in rolls or press brakes from flat steel, generally thicker 2mm.For repetitive mass production they are formed most economically by cold rolling, while smaller quantities of special shapes are most economically produced on press brakes. The latter process, with its great versatility of shape variation, makes this type of construction as adaptable to special requirements as reinforced concrete is in its field of use. Members are connected by spot, fillet, plug or slot welds, by screw, bolts, cold rivets or any other special devices. This type of construction is appropriate and economical under one or more of the following conditions:

- Where moderate loads and spans make the thicker, hot rolled shapes uneconomical, for example, joists purlins, girts, or trusses, complete framing for one and two storey residential, commercial and industrial structures.
- Where it is desired that load carrying members also provide useful surfaces, for example, panels and roof decks, mostly installed without any shoring and wall panels.
- Where sub-assemblies of such members can be prefabricated in the plant, reducing site erection to a minimum of simple operations, for example, sub- assembly of panel framing up to 3 x 4 m and more for structures.

DESIGN

Though composite construction is not a very new technique, its importance in structural construction is of recent realization in our country. With the advancement in the manufacture of structural units, composite construction has assumed great importance. It is a common knowledge that concrete is strong in compression but weak when subjected to tension, while steel is strong in tension but slender steel members are susceptible to buckling while under compressive forces. The fact that each material is used to take advantage of its positive attributes makes composite steel-concrete construction very efficient and economical. Composite section offer several advantages over non-composite sections. Since the load is carried jointly by the concrete slab and the steel beam, the size of the steel section is smaller than otherwise would be required. This reduces the overall height of the building and the steel tonnage required, thus resulting in a direct cost reduction. A composite beam is also stiffer than a non- composite beam of the same size and thus experiences less deflection and floor vibrations. An essential component of a composite beam is the shear connection between the steel section and the concrete slab.

One application that could serve the recycle triumph and eliminate environmental hazard is to go for alternative renewable resources. Concrete can be made cheaper by replacing of its fine

aggregate with natural or artificial light weight aggregates. This would produce a type of concrete that is lightweight and durable, which could be used in applications where great strength is not necessary but resistance to cycles of expansion and contraction is needed The use of quarry dust and glass fiber are partial replacement for fine aggregate for achieving light weight concrete has great potential to positively affect the properties of concrete in a wide spectrum.

OBJECTIVE

i) To determine the compressive strength of the concretes made from
   a) Quarry dust as Fine aggregates
   b) Glass Fiber as fine aggregates
ii) To select the better light weight concrete for further works with respect to its density, feasibility and considering economy
iii) To determine the ultimate strength capacity of shear connectors ductility characteristics of the Stud shear connectors in light weight concrete.
iv) To study the effects and modes of failure of concrete connection and shear connectors.

METHODOLOGY

The works have been carried out in two stages.

Stage – 1: To Obtain Light Weight Concrete

In the first stage of this experimental study, it was essential to obtain the better light weight concrete by having Quarry dust and Glass fiber as the alternatives for the normal fine aggregates. From the above three types of aggregates, it is found that the modified Glass fiber which satisfy all the strength and serviceability parameters.

Stage – 2: To Study The Flexural Behavior of Composite Beams

In the second stage of this investigation, the load carrying capacity of Stud shear connectors have been examined for the different arrangements of shear connectors in both conventional concrete and light weight concrete.

EXPERIMENTAL PROGRAM

In the present study, cold formed steel sections are formed in circular shape. The dimensions of steel section are diameter 10cm; height 60cm and thickness 4mm. and size of the concrete section are d =10 cm , h =60cm.The size of shear connector are 10 mm diameter and length =60cm, The arrangement of shear connector at 20 cm c/c and 10 cm from top.

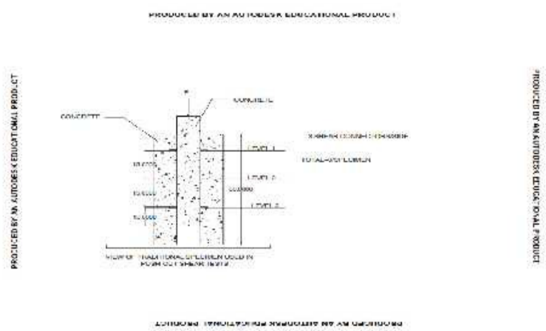

Fig.1 Specimen Model

A recess of 10cm in height to be provided between the bottom of the concrete and the lower end of the cold-formed steel section to allow for slip during testing.

MATERIALS, MIX AND CASTING

Locally available light gauge 14 kg grade steel sheet materials were properly shaped in the form of channel sections by pressing machine. Circular steel sections were connected back to back by 6mm bolts Materials used include P.P.C 53 grade, coarse aggregate of crushed rock (Max. size, 20 mm), fine aggregate of clean river sand (Zone II of IS: 383-1970) and potable water. A mix was designed as per IS 10262-2009 to achieve a concrete grade of M25.Concrete was manually placed in respective moulds. All specimens were well compacted manually without any voids. Specimens were demoulded after 24 hours.

PROPERTY OF MATERIALS

Table (1) Physical Properties of Fine Aggregate

Specific gravity	**2.64**
Fineness Modulus	**2.68**
Water Absorption	**1%**
Bulk density (kg/m3)	**1654**

Table (2) Physical Properties of Coarse Aggregate

Specific gravity	**2.79**
Fineness Modulus	**7.53**
Water Absorption	**0.75%**
Bulk density (kg/m3)	**1590**

CONCLUSION

The present experimental investigation has been done to determine the shear capacity of stud shear connectors in light weight concrete. The experimental investigation was proposed to determine strength characteristic of composite section with arrangement of stud shear connectors in both conventional and light weight concrete. The detailed analysis of compressive strength of concrete mixed with Quarry dust, glass fiber, and Quarry dust & glass fiber for various ratios .The experiment has been done to determine strength characteristics of both conventional fine aggregate concrete and partial replacement fine light weight concrete. The results of the cold formed steel-concrete composite specimen were compared with that of conventional specimen. Based on the results and observation of the experimental investigation, it was found that the increase in glass fiber will tend to increase the compressive strength and increase the bond strength between steel and concrete .The behavior of specimens in terms of compressive strength and shear strength crack development and the failure mode was observed from the test. The compressive strength of the concrete surface and deformation in steel stud were studied.

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